PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

High Efficiency Engines and Turbines

12/2002

CHARACTERIZATION OF CATALYTIC COMBUSTOR TURBULENCE AND ITS INFLUENCE ON VANE AND ENDWALL HEAT TRANSFER AND ENDWALL FILM COOLING

PRIMARY PARTNER

University of North Dakota

TOTAL ESTIMATED COST

$ 193,159

CUSTOMER SERVICE

800-553-7681

STRATEGIC CENTER FOR NATURAL GAS WEBSITE

www.netl.doe.gov/scng

Description

Under the Advanced Gas Turbine Systems Research (AGTSR) program, the University of North Dakota and a turbine manufacturer partner (Rolls Royce) are conducting evaluations to provide information significant to the design of first stage vanes and end walls downstream of advanced combustors. Task 1 conducts experiments to characterize the turbulence characteristics downstream of ultra low NO_X combustors. Task 2 obtains vane and end wall heat transfer data using two scaled vane cascade/endwall configurations and a range of turbulence conditions and velocities representative of advanced combustors. The second vane cascade/end wall will be designed by the turbine industry partner to take advantage of the lower turbulence levels for advanced combustors to produce a laminar or transitional boundary layer over much of the vanes which result in lower cooling requirements. Figure 1 shows the instrumented vane of the first cascade/endwall facility. Task 3 experimentally evaluates two end wall film-cooling geometries in both cascades. Tasks 4, 5 and 6 (conducted by the turbine industry partner) validate a 3-D RANS computer code using the data of Tasks 2 and 3 and apply the validated 3-D RANS code for engine relevant scale, temperatures, and flow velocities.

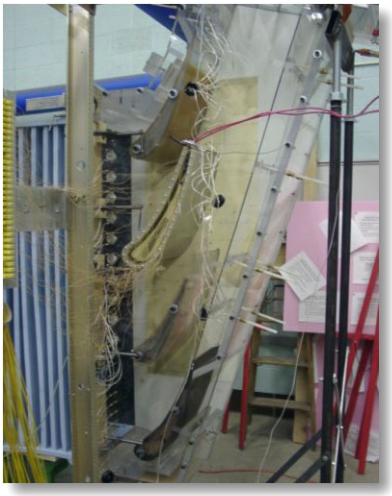

Figure 1. UND cascade facility

Characterization of Catalytic Combustor Turbulence and Its Influence on Vane and Endwall Heat Transfer and Endwall Film Cooling

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Duration

24 months

Goals

New ultra-low emission combustion systems will produce substantially different conditions in the turbine flow path than past turbine combustors. The flatter temperature patterns and lower turbulence levels for advanced combustors are new environments for first stage vanes and end walls. This project investigates and documents the influence of environments expected from advanced combustors on heat transfer and film cooling of turbine representative vane and end wall configurations.

Benefits

The project will produce information and data to assist turbine engineers in the cooling design of first stage vanes and end walls located down stream of advanced low emission combustors. The project will also explore innovative cooling concepts that take advantage of the new turbine flow path environments produced by advanced combustors